

Space Technology...

.... an Investment for the Future



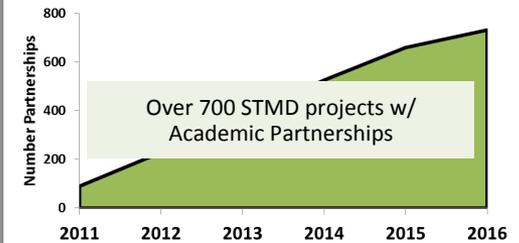
- Enables a **new NASA missions** beyond low Earth Orbit.
- **Delivers innovative solutions** that dramatically improve technological capabilities for NASA and the Nation.
- Develops technologies and capabilities that make NASA's missions **more affordable and more reliable**.
- **Engages the brightest minds** from academia and industry, including small businesses, in solving NASA's tough technological challenges.
- Invests in the economy by **creating markets and spurring innovation** for traditional and emerging aerospace business.

Addresses National Needs

A generation of studies and reports (40+ since 1980) document the need for regular investment in new, transformative space technologies.



Cumulative University Partnerships in Early Stage



STMD engages and supports:

NASA Capabilities
Academia
Small Businesses
The Broader Aerospace
Enterprise



Guiding Principles of the Space Technology Programs



- **Adhere to a Stakeholder Based Investment Strategy:** NASA Strategic Plan; NASA Space Tech Roadmaps / NRC Report; NASA Mission Directorate / Commercial advocacy
- **Invest in a Comprehensive Portfolio:** Covers low to high TRL; Grants & Fellowships; SBIR & prize competitions; prototype developments & technology demonstrations
- **Advance Transformative and Crosscutting Technologies:** Enabling or broadly applicable technologies with direct infusion into future missions
- **Develop Partnerships to Leverage Innovation and Resources:** Partnerships with Mission Directorates and OGAs to leverage limited funding and establish customer advocacy; Public – Private Partnerships to provide NASA resources and support to U.S. commercial aerospace interests
- **Select Using Merit Based Competition:** Research, innovation and technology maturation, open to academia, industry, NASA centers and OGAs
- **Execute with Lean Structured Projects:** Clear start and end dates, defined budgets and schedules, established milestones, lean development, and project level authority and accountability.
- **Infuse Rapidly or Terminate :** Operate with a sense of urgency; Rapid cadence of tech maturation; informed risk tolerance to implement / infuse quickly or terminate
- **Place NASA at technology's forefront – refresh Agency's capabilities:** Results in new inventions, creates a pipeline of NASA and national innovators, and refreshes the agencies technical capabilities

Space Technology Pipeline



Early Stage

- NASA Innovative Advanced Concepts
- Space Tech Research Grants
- Center Innovation Fund

Commercial Partnerships

- SBIR /STTR
- Flight Opportunities
- Centennial Challenges
- Regional Economic Development



TECHNOLOGY PIPELINE

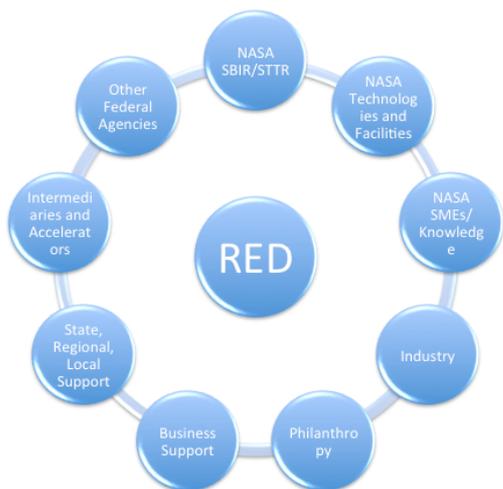
Commercial Partnerships Portfolio (CPP)



STMD created CPP to focus our investments in the commercial sector to address NASA needs and to stimulate space commercialization



- SBIR/STTR: Advance and infuse/commercialize new technologies developed by Small Businesses
- Flight Opportunities: Develop suborbital and small launch vehicle market in addition to maturing technologies for future missions
- Centennial Challenges: NASA's prize authority to conduct prize-based challenges of high public interest to advance technologies
- Regional Economic Development: Focused collaborations between NASA and multiple commercial entities within strategic geographic regions of interest





Flight Opportunities



Flight Opportunities facilitates technology development of innovative space technologies to:

- Reduce risk
- Reduce cost
- Improve performance
- Advance capabilities





Accessing Flight Opportunities



Multiple paths are available for developing and testing technologies

- **SpaceTech-REDDI Umbrella NRA**
 - Appendices issued for specific requirements:
 - External Call for Payloads Appendix
 - U.S.-based researchers receive funding to purchase proposed flight service directly from commercial providers
 - Tipping Point Technologies Appendix
 - Embraces public-private partnerships between NASA and US industry to expand capabilities in space
- **NASA Internal Calls for Payloads**
 - U.S. government researchers access testing via contracted commercial suborbital flight providers
- **Announcement of Collaborative Opportunity**
 - “Sister solicitation” to Tipping Point Appendix
 - Provide opportunities for industry-led effort



Currently Participating Organizations



Flight Services for REDDI & NASA Payloads



WORLD VIEW



zero G

ACO Public Private Partnerships



Vector Space

Innovate, Build, Fly



NOTE: Only showing flights purchased or conducted to date.
Researchers selected under REDDI are in the process of purchasing flight service from additional commercial providers.



Flight Opportunities Impacts



Gecko Grippers

A novel approach to grappling non-cooperative objects in microgravity



	Achievement	Outcome
2014	Parabolic flight test	Demonstrated grappling ability
2015	Parabolic flight test	Demonstrated mobility and free-floating grappling
2016	Deployment to ISS	Longer duration testing in microgravity



Testing helped researchers adjust design and demonstrate functionality in a realistic operational environment



Flight Opportunities Impacts



Additive Manufacturing Facility (AMF)

Enabling production of critical components in micro-gravity

MADE IN SPACE

	Achievement	Outcome
2011	Parabolic flight test	Technology optimization for microgravity
2013	SBIR Phase 3	Develop printer for ISS
2013	Parabolic flight test	Demonstrated effectiveness
2014	Deployment to ISS	Zero-Gravity 3D experimental printer operated successfully
2016	Deployment to ISS	AMF deployed as a permanent manufacturing facility on ISS



*In-flight observations enabled hardware/
software modifications and rapid
optimization for operation in microgravity*



Flight Opportunities Impacts

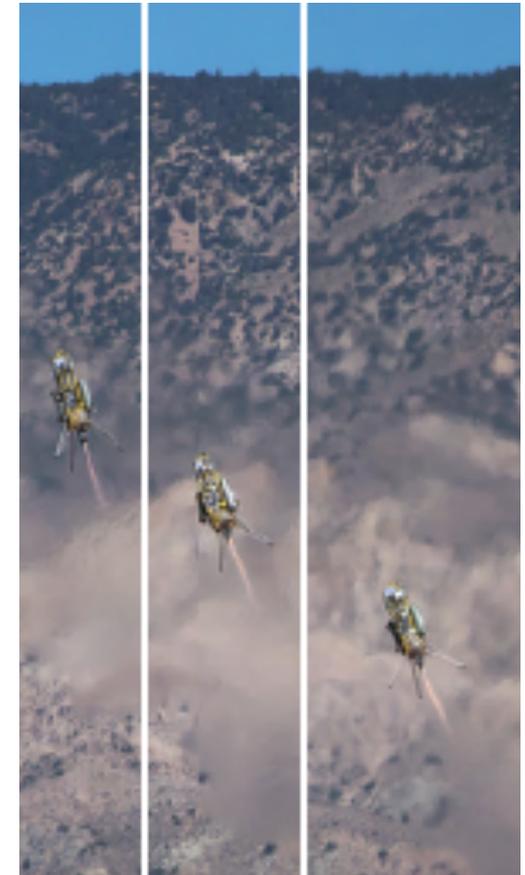


Mars Landing Technology

Enabling unprecedented precision for spacecraft landings



	Achievement	Outcome
2013	Vertical-launch/landing testing	Demonstrated navigation based on terrain-feature recognition and descent-course changing capabilities
2016	Baselined for Mars 2020 rover mission	System will assist with precision landing of Mars 2020 rover



Testing provided rapid, low-cost means to validate this technology and prove its ability to successfully direct entry, descent, and landing of spacecraft on any space target

New Flight Provider Selected



- Flight Opportunities program periodically runs a competition to add flight providers to the IDIQ-2 contract for NASA Internal Payloads
- Proposals were received and evaluated and a selection has been made





Congratulations

